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A CONTRIBUTION TO THE PATHOLOGY OF SOLITARY TUBERCLE OF THE SPINAL CORD.*

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THE exceedingly infrequent occurrence of massive or solitary tubercle within the substance of the spinal cord, and the difficulties which at present attend the recognition of the condition during life have rendered its study of comparatively little practical importance. Nevertheless there is reason to hope that some of the difficulties in diagnosis which now exist may be gradually removed by a careful study of the cases that from time to time occur and of those that have been reported, and it is with such a possibility in mind that this paper has been prepared.

The paper consists of a report on the clinical history and pathological anatomy of three hitherto unpublished cases of solitary tubercle of the cord, and of a brief analysis of the clinical and pathological features of the condition based on these cases and on those which have been collected from the literature.

The following is a report of the new cases. The clinical histories of these cases are in some respects incomplete, but not sufficiently so to destroy their value for the present purpose.

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CASE I.—W. S., aged twenty-eight. Waiter. Admitted to Dr. Ball's service at St. Luke's Hospital January 3d, 1890. Gives family history of phthisis, mother and two maternal aunts having died of this disease. Also gives usual personal history of pulmonary phthisis, dating back about one year. About three months ago the patient developed tubercular epidydimitis of right testicle.

At time of admission he was anæmic and emaciated and a physical examination revealed the ordinary signs of tubercular disease at the apex of either lung.

Two weeks before admission the patient was able to walk without difficulty and had no symptoms suggestive of organic disease of the nervous system. Headache, it is true, was present much of the time, but was not of the character to lead to a suspicion of intra-cranial disease. Apparently the first symptoms of spinal cord disease were spasmodic pain and occasional rigidity in the lower extremities. Then there developed rather rapidly weakness of the left leg and hyperalgesia of both legs. Very soon the weakness extended to the right leg and the hyperalgesia became decided and constant.

Occasional attacks of severe pain occurred as time advanced. The motor paralysis grew rather rapidly worse, but the loss of power continued more marked in the left leg. Anæsthesia of the lower extremities was not noted, but may have been present.

An examination a few weeks before death showed that the knee-jerks were very active and that ankle-clonus could be obtained on either side.

A few days before death the patient complained of a girdle-pain about the waist.

On Feb. 15th, not quite six weeks after admission to the medical wards of the hospital, the patient died in stupor. For several days before his death he was semi-comitose or delirious, and had a high temperature. Toward the end the paralysis of the left leg was all but absolute.

The autopsy, by Dr. Thatcher[2], showed the existence of wide-spread tubercular disease. The lungs were the seat of numerous clusters of miliary tubercles, which were located chiefly in the upper lobes, and contained a few small cheesy nodules.

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[2] I am indebted to Dr. Thatcher both for the notes of the autopsy and the specimen.

The bronchial glands were enlarged and cheesy. The omentum showed numerous adhesions. The mesenteric glands were prominent and a little cheesy. The intestines were the seat of numerous ulcers.

The kidneys and ureters were free from tubercular disease, but the left supra-renal capsule was almost entirely replaced by a cheesy mass. The tunica vaginalis of the right testicle was adherent, and both epidydimis and testicle were enlarged and cheesy.

The prostate was enlarged and contained a cheesy mass in its left lobe. The seminal vesicle and commencement of the vas deferens on the left side were cheesy. The brain was the seat of several massive tubercles. Of these, three were in the cerebellum. One of them, about one-half inch in diameter, was in the posterior edge of the left cerebellar hemisphere. This nodule extended to within an inch of the posterior median fissure and to within a quarter-inch of the posterior surface of the cerebellum.

Another, somewhat larger than the first, was situated almost symmetrically with it in the right cerebellar hemisphere. It reached into the cortex of the cerebellum. Just below and external to this nodule was another of smaller size. Another cheesy mass of the same character occupied the anterior extremity of the right optic thalamus. Along the fissure of sylvius was a yellowish exudation into the pia.

In the 7th and 8th dorsal segments of the spinal cord was a rounded cheesy nodule with a grayish border. This nodule was about three-quarters of an inch in vertical extent. At the level of its greatest diameter the mass occupied almost the entire area of the left half of the cord, extending to within one-sixteenth of an inch of its peryphery in front and behind. The right side of the cord was also encroached upon to a considerable extent, but a large part of its white substance, especially that of the lateral columns, was intact. Just above and below the tumor the cord was slightly softer than normal. When the cord was hardened in Muller's fluid, secondary degenerative changes were observed in certain white tracts above and below the mass. Below the tubercle the crossed pyramidal tracts of either side were degenerated, the appearance indicating that the process was a little more advanced on the side of the tumor than on the opposite side. Above the tubercle the changes were limited throughout their extent to the posterior median columns, neither the direct cerebellar tract nor the column of Gowers appearing to be implicated.

The position of the degenerated areas in the posterior columns was unusual and deserves brief mention. In the dorsal region, just above the tumor, the degeneration was confined to a small strip on either side of the posterior median fissure at its anterior extremity. These strips were oblong in contour, lay close to the fissure, and extended but a short distance back from the posterior commissure. The degenerated area was larger and more distinct at this level on the left side, *i.e.*, on the side most invaded by the tumor. In the upper dorsal region the degenerated areas still occupied the anterior part of the posterior median columns, but no longer extended to the posterior commissure anteriorly, though they came correspondingly nearer the periphery of the cord. In the cervical region the degeneration occupied on either side a triangular area whose apex reached nearly to the posterior commissure, and whose base was formed by the periphery of the cord bounding the posterior median column. In other words, the degeneration was here more extensive than at other levels and occupied another part of the posterior median column. Above this level the degenerated areas seemed to occupy the entire posterior median column. Above the post-pyramidal nuclei the degeneration could not be traced.

The microscopical examination confirmed what has been said about the position of the secondary degenerations. It is interesting to note, however, that the degree of degenerative change in the area described was much less than might have been expected from the appearances ; a considerable number of the fibres in these areas were normal, and the amount of interstitial tissue was slight. The appearances made it highly probable that the tumor began in the gray matter of the left half of the cord.

There was nothing unusual about the structure of the tubercle itself. The appearances were strongly suggestive of its conglomerate character. Tubercle bacilli were found in small numbers in each section of the mass examined. They were confined almost exclusively to the giant cells which lay in the periphery of the growth external to its cheesy portion. Many of the giant-cells were without tubercle bacilli. Some of them contained one or two bacilli and a small number contained three or four. About the tubercle itself was a zone of white substance, containing normal nerve-fibres, but infiltrated in places with small spheroidal cells. In the left half of the cord the tubercle at one part comes to the periphery ; in other parts the zone of white substance is very narrow. There was no meningitis.

The points of special interest in this case are the rather rapid attainment by the spinal symptoms of a considerable degree of intensity, the great preponderance of the symptoms of tissue destruction over those of tissue irritation, of paralysis over spasm and pain, and the slight indications of intra-cranial disease.

CASE II.—Mary K., aged thirty-five, married ; housewife. Admitted to Roosevelt Hospital Feb. 27th, 1886, in the service of Dr. Watts. Family history negative. Patient began to menstruate at the age of fourteen, and was regular until seven months ago. She was married when twenty-three years of age and had six living children, one still-birth one year ago, and a miscarriage seven months ago. Since this miscarriage the patient's health has been failing, her menstruation has been very irregular, and she has suffered much loss of blood from menorrhagia and metrorrhagia. She has also had a leucorrhœal discharge ever since the miscarriage, and has been troubled with pain in the back and limbs, and with headache. For some time before admission to the hospital she observed that the effort of lifting one of her children sometimes gave rise to nausea and vomiting.

Six weeks before admission the patient became conscious of some diminution in the power of the lower extremities. This loss of power increased gradually, and at the time of admission her legs had become so weak that she was unable to walk.

During the patient's stay in the hospital she frequently complained of pain in the legs, back and head. At times the headache was very severe. There was apparently an elevation of temperature most of the time.

It was noted at the time of admission that the knee-jerks were present, but an examination about twenty days afterward showed that there was bilateral loss of knee-jerk. At the same time it was noted that there were areas of diminished sensibility to pain, and areas of analgesia on the lower extremities, but the precise distribution of the sensory loss was not recorded.

The right leg was at this time completely paralyzed. The left was all but powerless. There was retention of urine from the time of admission.

On March 20th, when the patient had been in the hospital about three weeks, it was noted that there was a bilateral diminution of hearing.

On the day following a bed-sore began to form on the sacrum, and delirium set in. The delirium continued, rigidity of the muscles of the back of the neck appeared, and the head was rotated to the right. Internal strabismus soon appeared in the right eye, with dilatation of the pupil, and loss of light reflex of the same side.

On March 30th, a little more than one month after admission, the patient died.

The autopsy was made by Dr. Delafield. The lungs were found to be thickly studded with miliary tubercles. The spleen was rather small, and contained miliary tubercles. The cortical substance of the kidney was congested and was the seat of tubercles. The external os of the uterus was widely dilated. The wall of the uterus was thickened and its inner surface was congested and studded with very small miliary tubercles.

The walls of both fallopian tubes were uniformly thickened throughout their entire length with a greyish gelatinous material, which was nowhere cheesy. The stomach and intestines were normal. The pia-mater of the brain was congested and a little thickened and opaque, especially over the base, where there were also very small miliary tubercles. The lateral ventricles were distended with serum, and there were very fine tubercle granules in the ependyma.

The pia of the spinal cord was infiltrated with turbid serum and thickly studded with miliary tubercles. Just below the brachial enlargement the cord was completely softened and broken down in about one inch of its vertical extent. In the lumbar enlargement of the cord was a spheroidal tubercular mass about three-eighths of an inch in diameter, with a cheesy centre, occupying chiefly the right half of the cord, but encroaching to some extent upon the opposite side. The mass was situated in the third lumbar segment of the cord. In the right half of the cord it replaced the grey substance and most of the anterior and lateral column at the level of its greatest diameter. The posterior column was intact in the greater part of its extent.

In the left side of the cord at this level the anterior horn was implicated, the white substance very little or not at all.

A microscopical examination showed the conglomerate character of the tubercular mass, and sections through the upper and lower end of the mass strongly suggested that the original deposition of tubercle was in the anterior horn of the right side. Tubercle bacilli were present in moderate numbers; the pia-mater was thickened and densely infiltrated with small spheroidal cells, and the periphery of the cord was similarly infiltrated, though there was here a tendency to the formation of distinct foci of inflammatory material. Many of the pial vessels were the seat of an advanced endarteritis. There was neither macroscopical nor microscopical evidence of secondary degenerations above or below the tumor.

It is interesting to note in this case, as in the one first recited, the relatively rapid development of symptoms indicative of an intra-spinal tumor, and the prominence of symptoms of tissue destruction as compared with those of an irritative character.

From the standpoint of spinal localization it is instructive to observe the relation which we must assume to exist in this case between the loss of knee-jerk and a destructive process limited to the structures of the third lumbar segment of the cord.

CASE III.—This case is of interest chiefly from a pathological point of view. The clinical history is meagre. H. B., five years of age, gave a history of Pott's disease and of tubercular synovitis of the knee of some months duration. Both knee-joints were opened, and for nearly three months the patient did well. Then he developed the typical symptoms of tubercular meningitis, and died.

The autopsy revealed the existence of old and recent tuberculosis of the lungs. There was a well-marked kyphos in the lower part of the dorsal region, the bodies of two or three of the lower dorsal vertebræ being carious, and permitting the formation of a sharp angle externally. The diseased bodies of the vertebræ were in part replaced with cheesy matter and bone debris. Just above the lumbar enlargement of the cord the inflammatory products encroached upon the dura, but the cord was not visibly compressed. In the upper lumbar region of the cord itself was a small mass about the size of a pea, composed apparently of several grey tubercles. The brain showed the appearance of tubercular meningitis.

Microscopical examination of the cord showed the existence of a considerable degree of leptomeningitis, at the level of the bone disease and the grey tubercles just mentioned. This meningitis was most marked on the anterior surface of the cord, and was intense in the anterior median fissure. At the bottom of the fissure the inflamed pia was adherent to the substance of the cord. The grey commissure of the cord, especially its left half, and the anterior horn of the left side, were the seat of several tubercles, some of which had coalesced. The products of inflammation had nowhere become cheesy.

The precise limits of the tubercular infiltration of the grey substance could not be determined, as a segment of the left half of the cord had been injured. The process was apparently confined to the grey matter. The right side of the cord was intact. The central canal of the cord was displaced to the left and its contour altered, but its lining epithelia were unchanged.

Tubercle bacilli were found in very small numbers in the giant cells.

There was no softening about the tubercular deposit and there were no secondary degenerations. The dura-mater at the level of the tubercle was altered in color in a circumscribed area of its inner surface near the anterior fissure of the cord. Examination showed the vessels of the dura at this spot to be enlarged and surrounded with accumulations of small spheroidal cells. The layers of the dura were also infiltrated with similar cells. The external surface of the dura was in contact with the inflammatory products resulting from the bone disease.

It is difficult to reach any conclusion except that there was in this instance a continuity of lesion between the bone disease and the tubercle of the cord.

It is instructive to examine the records of the cases of solitary tubercle of the spinal cord which have been hitherto published, in connection with the cases just recited, in order to determine what conclusions may legitimately be reached respecting the occurrence, clinical history and pathology of this disease.

Some of the cases published by the older authors are unreliable and must be partly or entirely discarded. In all, there are nine cases, of which the records are sufficiently detailed to enable us to form a picture of their essential features. These are the cases of Chvostck[3] (two cases), Habershon,[4] Eisenschutz,[5] Williams,[6] Kolitz,[7] Obolonsky,[8] Sachs,[9] and Hayem.[10]

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[3] Med. Presse, 33-39. 1873.

[4] Guy's Hospital Reports, 1872.

[5] Tuberkel des Ruckenmarks. Jahrb. f. Kinderheilk, 1870.

[6] Deutsches Archiv f. klin. Med., xxv., 1880. Report of Autopsy by Schultze.

[7] Ueber Ruckenmarkstumoren in Kindesalten. Wien. med. Blatt., 41-43, 1885.

[8] Ueber einen Fall von Ruckenmarkstuberculosie, etc. Zeit f. Heilk, Bd. IX , S. 400.

[9] A Contribution to the Study of Tumor of the Spinal Cord. J. N. and M. Dis., 1886.

[10] Obs. pour servir à l'histoire des tubercles de la Moelle épinière. Arch. de Phys. Norm., etc., 1873.

In addition to these cases there are a number of others, from each of which certain facts are available for statistical purposes. Such cases are those of Hellick,[11] Liouville,[12] (two cases), Serres, Dupurteau, Brichetlet, Tolling, Bichau, Gendreu, and Gull. Finally, Dr. Janeway of New York, and Dr. Thomas of Baltimore, have furnished me with some facts relating to the pathological findings in two cases of massive tubercle of the cord.

The study of twenty-four cases, in which the age is recorded, shows that solitary tubercle of the cord is a disease of the adolescent and early adult period of life, and of infancy, fifteen of these cases having occurred between the ages of 15 and 35, and five of them before the fifth year. Eight months is the earliest and forty-three years the latest period of occurrence noted. In eight of eleven cases in which the sex is given the patients were males. The facts do not warrant the expression of a positive opinion regarding the existence of a family history of phthisis, or of acquired syphilis, but in a large proportion of the cases after childhood neither of these conditions appear to have been present. An injury was noted as an etiological factor in only one case.

It would be superfluous to state that solitary tubercle of the cord gives rise to pronounced symptoms, were it not for the fact that some authors consider it not uncommon for this condition to give rise to no symptomatic manifestations. In one case, indeed, that of Schultze, a small tubercular mass occupied part of one lateral column of the cord and produced no symptoms during life. It is quite possible that in this instance slight symptoms would have been overlooked. but, granting that there were no symptoms whatever, this immunity might be explained by the circumstance that the patient died while the dimensions of the tumor were still very small, and by the fact that microscopical examination showed the nerve elements of the lateral column to have been displaced rather than destroyed.

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[11] Considérations sur les lesions de la Moelle, etc. Arch. Bolem. de Méd., No. 1, 1887.

[12] Nouveaux examples de lesions tuberculoses dans la Moelle épinière. Arch. Gen. de Med., '75.

In all the other cases in which there were careful records, there were marked symptoms. In almost all these cases the earliest symptoms were pain and weakness of one extremity. Which of these symptoms is usually the earliest it is difficult to say, as the records are not sufficiently explicit. It is an important fact that both of these manifestations, together with the paræsthesia that often existed with them, were for a time either entirely or chiefly unilateral. Very soon the symptoms became bilateral. The loss of power became more marked, and in most cases ultimately became almost complete.

Anæsthesia was generally present. The pains continued and were associated with spasm. Irritative symptoms appear to have been present in every case in which the symptoms were carefully recorded. In a few instances they were intense. In the majority they were slight.

No statements can be made regarding the precise distribution either of the sensory or of the motor paralysis, as the data are lacking. Spasm does not appear to have been a conspicuous symptom. It was noted in more than half the cases. In one case it was very marked. In another it was present only on walking. In general the symptoms of tissue destruction have predominated over those of irritation, and this disproportion was very decided in cases I. and II. related in this paper.

The rapidity with which the symptoms have attained a considerable degree of intensity is a striking feature in eight of the nine cases in which the data enable a conclusion regarding this point to be drawn. In these eight cases the time that elapsed between the commencement of the symptoms and their attainment of marked intensity (considerable degree of paralysis, etc,), varied from three to eight weeks. No precise statement can be made regarding the time at which the symptoms reached their fullest development. Most of the cases appear to have run their course in about two months from the commencement of symptoms. In the case which forms an exception to this rule (Chvostck) the symptoms did not attain much intensity until seven months had passed.

In twenty-five cases of tubercular tumor of the cord only one tumor was described. In one case (Janeway) there were several, but the exact number was not noted.

It is certainly safe to assume that massive tubercle is solitary in a very large proportion of cases.

The records relative to the development of symptoms of tubercular disease in other parts of the body are unsatisfactory. They seem to justify the conclusion, however, that such symptoms existed in most of the cases. Usually the symptoms were those of pulmonary phthisis and occurred early in the course of the cord symptoms. They may be regarded, therefore, as a material aid in diagnosis.

Of sixteen cases in which the position of the tumor was noted, five were in the cervical region, seven in the dorsal, and three in the lumbar region. In the remainining case the tubercle was at the junction of the dorsal and lumbar regions. The cases are certainly too few to justify a precise conclusion regarding the relative frequency of massive tubercle in different parts of the cord, but they suggest that it occurs with about equal frequency in the lumbar and cervical cord, and that it is observed more often in the dorsal than in the cervical or lumbar region. It may be confidently asserted that the statement of Hayem and others that the lumbar enlargement is the favorite seat of massive tubercle is incorrect.

The description of previously published cases do not teach us much about the structural features of massive tubercle of the cord. The three cases here reported make it plain that in these cases the tubercular mass resulted from the coalescence of several tubercles, and it is probable that most, if not all cases of developed solitary tubercle are conglomerate in character.

In two of the three cases just mentioned the masses attained a considerable size and had cheesy centres. In the third case the tubercular deposit occupied an irregular and small area and had not undergone cheesy degeneration at any part. Tubercle bacilli were found in five cases (Obolonskey, Hellich, 3 cases here reported). They were present in small numbers in four of these cases. In the remaining case (Hellich) they were abundant.

In the case of Sachs, and in the three cases which form the substance of this paper, the tubercular process occupied at first only one lateral half of the cord, and the unilateral character of the early symptoms in all the cases in which the early symptoms were noted, makes it more than probable that a one-sided growth of tubercle tissue is the rule.

Cases I., II. and III., of this paper indicate a beginning of the process in the gray matter, and in the case of Sachs the first deposition of tubercle tissue was in the vicinity of the posterior nerve-roots. In the case of Schultze, the beginning seems to have been in one lateral column.

In four cases secondary degeneration were found. In three of these there were both ascending and descending degenerations. In the fourth case there was a descending degeneration only. In ten cases no secondary degeneration was noted. Why these secondary processes were present in some instances and not in others, the facts at command do not enable us to decide. It may be surmised, however, that the ordinarily short course of the disease is at least a partial explanation of the absence of the secondary degeneration in so large a proportion of cases. In some of the cases (*e.g.*, that of Sachs) the duration of the process was longer than that required for secondary degeneration to occur, but it is to be remembered that the tracts which degenerate were probably not involved during this entire period. In case I., here described, the degenerative changes in the various tracts were only slightly advanced, a circumstance which indicates the importance of the time element.

Meningitis of the cord was noticed in several cases. It depended in most instances on the extension of meningitis from the cerebral meninges. Where the tumor grew so large as to reach the periphery of the cord a localized meningitis was sometimes set up. Softening about the tumor, sometimes of a myelitic character, was noted in more than half the cases. It was absent in the cases where the tumor was small, and it is possible that its occurrence was related to the size of the tubercle.

There can be little doubt that solitary tubercle of the cord is generally secondary to tubercular disease in other parts of the body. Hayem, however, regards his case as one of primary disease of the cord. The lungs and intestines were the seat of tubercular disease in this case, and it appears most improbable that these parts should have been involved secondarily. It is possible that in some instances the tubercle bacilli may have lodged in the cord and in the other affected organs, at about the same time and in consequence of the same infection.

In eleven of twelve cases in which the histories give light on this point, tuberculosis of the lungs existed. In the remaining case there was tubrecular meningitis. In none of the eleven cases just mentioned was the tubercular disease confined to the lungs and to the cord.

Tubercular meningitis existed in two of them. In two others there was massive tubercle of the brain, in several there was tubercular disease of the intestine, and in several tubercular disease of the kidney. In two cases there was tubercular disease of the uterus, and in one of them (Case II.) the uterine disease was probably primary. In one case (Case I.) there was extensive disease of the male genito-urinary tract, and here also the process was not improbably primary. In another case (Case III.) there was vertebral disease and tubercular arthritis.

It is more than likely that the lodgment of tubercle bacilli in the cord, on which we must assume the growth of the massive tubercle to depend, is effected through the circulation. Yet it is instructive to note that in rare instances the process extends to the cord by direct continuity of lesion, and probably through the medium of the lymphatics. This was certainly so in Case III. here reported.

It is believed that the clinical history of solitary tubercle of the cord can be more accurately written than heretofore with the help of the facts that have been recorded above. The uniformity of the symptoms in different cases, especially as regards their rapld course, the rapidity with which the originally unilateral symptoms become bilateral, the comparative insignificance of irritative phenomena, and the frequency wiih which the signs of tubercular disease in other organs exist, are characters of solitary tubercle of the cord which may help in the distinction both from tumor of the membranes and from other varieties of tumor of the cord.

DISCUSSION.

Dr. **Sachs** said it was some years since his paper on this subject was written. At that time he had thought that the very slow development, the strictly unilateral symptoms and subsequent spread of the disease, involving both halves, would constitute a basis for diagnosis of tubercle of the cord. Now the point came up with regard to the possibility of distinguishing between extra and intra dural tumors.

THE MECHANISM OF INSANITY.

The "Journal of Insanity" for April, 1890, contains a paper by Edward Cowles, with the above title. First is considered the normal mechanism of mind and body, then, reflex action. Following these there is an exposition of mental mechanism thus arrayed: consciousness; apperception; attention; sense-perception; memory, imagination; conception, reason, judgment; feelings, emotions, conscience; willing and acting; and subconsciousness.

THE EFFECT OF ANTIPYRIN ON THE SOLUBILITY OF CAFFEINE.

The "Therapeutic Gazette," April 15, 1890, calls attention to the fact that antipyrin possesses the property of increasing the solubility of quinine salts and likewise that of caffeine. Added to caffeine in equal parts, antipyrin renders the drug perfectly soluble in cold water. (See "Repertoire de pharmacie," Feb. 10, 1890.) With warm water, it is claimed that it is possible to dissolve seven and one-half grains of caffeine in one hundred and sixty minims of distilled water, by the addition of twelve grains of antipyrin, and that the solution so produced is permanently limpid. This increased solubility of caffeine favors its subcutaneous administration, since through its aid fifteen grains of caffeine may be dissolved in three ounces of water. Thus the use of the drug in neuralgia and migraine becomes greatly facilitated by the addition of antipyrin, and the probability of cure increased.